CLAIMS

What is claimed is:

1. A composite comprising
a porous carbon structure comprising a surface and pores; and
a coating on the surface comprising an electroactive polymer;
wherein the coating does not completely fill or obstruct a majority of the pores.

2. The composite of claim 1, wherein the structure is a carbon aerogel.

3. The composite of claim 1, wherein the structure is selected from the group consisting of carbon nanofoam and templated mesoporous carbon.

4. The composite of claim 1, wherein the pores have an average diameter of from about 2 nm to about 1 μm.

5. The composite of claim 1, wherein the polymer is a conductive polymer.

6. The composite of claim 1, wherein the polymer is a polyaniline or derivative thereof.

7. The composite of claim 1, wherein the polymer is selected from group consisting of a redox polymer, a polyarylamine, a polypyrrole, polyacetylene, a polythiophene, and derivatives thereof.

8. The composite of claim 1, wherein the coating has a thickness of no more than about 10 nm.

9. The composite of claim 1, wherein the coating is formed by self-limiting electropolymerization.

10. A capacitor comprising an anode, a cathode, and an electrolyte, wherein the anode, the cathode, or both comprise:

a composite comprising

a porous carbon structure comprising a surface and pores; and

a coating on the surface comprising an electroactive polymer;

wherein the coating does not completely fill or obstruct a majority of the pores; and

a current collector in electrical contact with the composite.

11. The capacitor of claim 10, wherein the structure is a carbon aerogel.

12. The capacitor of claim 10, wherein the structure is selected from the group consisting of carbon nanofoam and templated mesoporous carbon.

13. The capacitor of claim 10, wherein the pores have an average diameter of from about 2 nm to about 1 μm.

14. The capacitor of claim 10, wherein the polymer is a conductive polymer.

15. The capacitor of claim 10, wherein the polymer is a polyaniline or derivative thereof.

16. The capacitor of claim 10, wherein the polymer is selected from group consisting of a redox polymer, a polyarylamine, a polypyrrole, polyacetylene, a polythiophene, and derivatives thereof.

17. The capacitor of claim 10, wherein the coating has a thickness of no more than about 10 nm.

18. The capacitor of claim 10, wherein the coating is formed by self-limiting electropolymerization.

19. The capacitor of claim 10, wherein the electrolyte comprises sulfuric acid.

20. The capacitor of claim 10, wherein the electrolyte comprises a liquid selected from the group consisting of an aqueous acid and a protonic ionic liquid.

21. A method of forming a composite comprising the steps of:
providing porous carbon structure comprising a surface and pores;
infiltrating the structure with a monomer which can form an electroactive polymer; and
electropolymerizing the monomer forming a coating on the surface comprising the electroactive polymer without completely filling or obstructing a majority of the pores.

22. The method of claim 21, wherein the structure is a carbon aerogel.

23. The method of claim 21, wherein the structure is selected from the group consisting of carbon nanofoam and templated mesoporous carbon.

24. The method of claim 21, wherein the pores have an average diameter of from about 2 nm to about 1 μm.

25. The method of claim 21, wherein the polymer is a conductive polymer.

26. The method of claim 21, wherein the polymer is a polyaniline or derivative thereof.

27. The method of claim 21, wherein the polymer is selected from group consisting of a redox polymer, a polyarylamine, a polypyrrole, polyacetylene, a polythiophene, and derivatives thereof.

28. The method of claim 21, wherein the electropolymerization step comprises self-limiting electropolymerization.

29. The method of claim 21, wherein the coating has a thickness of no more than about 10 nm.

30. The method of claim 21, wherein the infiltrating step comprises immersing the structure in a solution of the monomer.

31. A method of storing charge comprising the steps of:

providing a capacitor comprising an anode, a cathode, and an electrolyte, wherein the anode, the cathode, or both comprise:

a composite comprising

a porous carbon structure comprising a surface and pores; and

a coating on the surface comprising an electroactive polymer;

wherein the coating does not completely fill or obstruct a majority of the pores; and

a current collector in electrical contact with the composite; and

charging the capacitor.

32. The method of claim 31, wherein the structure is a carbon aerogel.

33. The method of claim 31, wherein the structure is selected from the group consisting of carbon nanofoam and templated carbon.

34. The method of claim 31, wherein the pores have an average diameter of from about 2 nm to about 1 μm.

35. The method of claim 31, wherein the polymer is a conductive polymer.

36. The method of claim 31, wherein the polymer is a polyaniline or derivative thereof.

37. The method of claim 31, wherein the polymer is selected from group consisting of a redox polymer, a polyarylamine, a polypyrrole, polyacetylene a polythiophene, and derivatives thereof.

38. The method of claim 31, wherein the coating has a thickness of no more than about 10 nm.

39. The method of claim 31, wherein the coating is formed by self-limiting electropolymerization.

40. The method of claim 31, wherein the electrolyte comprises sulfuric acid.

41. The method of claim 31, wherein the electrolyte comprises a liquid selected from the group consisting of an aqueous acid and a protonic ionic liquid.